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THE DEVELOPMENT OF PULSE-BASED PUREED FOODS

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The Development of Pulse-based Pureed Foods

Final Report

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Abstract Summary

Pureed foods intended for swallowing disordered, long term care (LTC) residents often lack appropriate textural qualities, sensory acceptability and nutrient density. The objectives of this project were to develop texturally-appropriate, sensory-acceptable and nutrient-dense, pulse-based pureed food formulations, and then to evaluate the effect of consuming these foods on a particular marker of nutritional status, serum homocysteine, in LTC residents offered a pureed diet. Thirty-seven pulse-based pureed food formulations were developed. Sensory evaluation of ten formulations was carried out by LTC residents, family and staff. A five-point Likert ranking scale of aroma, flavour, stickiness/smoothness, ease of swallowing and overall acceptability was used to determine acceptability. Textural analyses, including hardness and adhesiveness were carried out by Texture Profile Analysis and spooned weight was also determined. Pulse-based pureed desserts were prepared and incorporated into the institutional pureed menu at Parkridge Center, Saskatoon, SK for a period of eight weeks. Three-day food and nutrient intake was assessed at baseline and following the addition of the pulse-based pureed foods, as well as a selection of commercial pureed foods. Serum homocysteine of 12 LTC residents consuming pureed foods was assessed at baseline and week eight of the study. Mean acceptability of all the purees was 4.0 ± 1.0 (1 = unacceptable; 5 = very acceptable). The mean "ease of swallow" of all the purees was 4.3 ± 0.9 (1 = difficult to swallow; 5 = easy to swallow), aroma was 3.0 ± 1.3 (1 = not detectable; 5 = clearly detectable), flavor intensity was 4.0 ± 1.0 (1 = no flavour; 5 = strong flavour), smoothness was ranked 2.4 ± 1.1 (1 = very smooth; 5 = grainy) and stickiness or adhesiveness was ranked 2.6 ± 1.1 (1 = not sticky 5 = very sticky). Mean hardness, adhesiveness and spooned weight of the pulse-based pureed foods were 7.9 ± 3.8 N, 5.2 ± 3.5 N·cm and 16.1 ± 3.4 g, respectively, achieving "pudding" consistency. Only some pulse-based products were incorporated into the pureed menu, due to constraints with staff time and capability. The addition of pulse-based pureed desserts and commercial pureed foods did not result in significant changes in marginal nutrients and the intervention had no significant effect on serum homocysteine in the 12 subjects measured. Pulse-based pureed foods, high in folate, are texturally-appropriate, sensory-

acceptable and easy to swallow; thus these products should be served more often. Pulse-based pureed foods are better suited to be produced commercially than made in-house by staff in care facilities, due to food service staffing constraints and limited technical capabilities with in food service departments.

Introduction

Malnutrition in institutionalized individuals is a serious issue and those with dysphagia, are at particular risk (1). A significant number of LTC residents, with evidence of dysphagia, are provided texture-modified foods to maintain or achieve normal food intake while reducing the risks of aspiration and choking (2); up to 20% of LTC residents are offered pureed foods (3,4). The preparation of texturally-appropriate and sensory acceptable pureed foods, particularly breads and pastas, is challenging (4).

We undertook a preliminary investigation into whether residents of LTC facilities served pureed foods, i.e., residents are exclusively dependent on food offered in their facility, were receiving the benefit of folate fortification. These residents were offered few fortified grain products, fruits, vegetables and legumes, all of which are rich in natural sources of folate (5). Weighed audits of pureed food offered and plate waste in two LTC facilities indicated that the average folate intake of 20 individuals receiving pureed food was 188 µg/day (range: 28-400 µg/day), much less than recommended (5). Longer stay residents may be at increased risk of developing dementia symptoms and heart disease as a result of being provided a folate deficient diet.

Although folate could be provided to LTC residents through vitamin prescriptions, research has demonstrated that compliance to the delivery of vitamin and mineral prescriptions to dysphagic LTC residents may be poor (6). As most dysphagic individuals would be challenged to swallow folic acid in pill form, the provision of folic acid in liquid form, not commonly available, would be necessary. However, vitamin supplementation should not preclude the provision of a nutritionally adequate diet. In addition, the provision of foods high in folate such as pulses, should lead to increased intakes of other marginal nutrients, such as protein and fibre.

Folate and Health

Folate has become the focus of much research in recent years due to the strong relationship between folate status and serum homocysteine (7,8,9). A strong association exists between elevated homocysteine levels and an increased risk of cardiovascular disease (10) and neurological dysfunction (11). Hyperhomocysteinemia poses a significant risk factor for vascular disease and folic acid is of benefit (12). Folate therapy

is the most effective treatment for hyperhomocysteinemia (13). Folate is also believed to be involved in mood regulation and related neurological disorders such as Alzheimer's disease and that hyperhomocysteinemia contributes to dementia (14).

Malnutrition and Dysphagia

Malnutrition is a serious problem for residents of LTC facilities (1,15). It has been estimated that elderly populations have vitamin and mineral intakes that are less than the recommended intakes (16,17). Poor nutrition in the elderly is related to increased risk of illness and morbidity (18).

Dysphagia symptoms affect as many as three in four LTC residents (19). LTC residents who suffer from serious dysphagia often require pureed diets. Meeting folate requirements of dysphagic residents is challenging, as they have less food choices, consume fewer calories, and may not be receiving necessary supplementation. An issue of compliance to a supplement regimen is also of relevance if dysphagic residents are attempting to swallow solid rather than liquid dosage forms (6).

Currently, precooked rice is fortified at 0.016mg/100g, flour at 0.15 mg/100g, bread at 0.1 mg/100g and breakfast cereal at 0.06 mg/100g in Canada (20). Unfortunately, grain products such as breads, pastas, rice, pancakes, cookies and cake are not often prepared long term homes in our province (5). Instead potatoes, offering little folate and other nutrients, are served quite frequently (up to two meals a day at some LTC facilities).

Pureed Food Development

Dietary management strategies for many dysphagic conditions recommend moist, semi-solid foods that can maintain a cohesive bolus (2). Current therapeutic diet standards have responded to this requirement with recommendations that a pureed food should have a "spoon thick" or "pudding-like" consistency, be thick and homogenous, and have no coarse textures (2), and the Level 1: Dysphagia Pureed of the National Dysphagic Diet Task Force indicated that any foods requiring bolus formation, controlled manipulation and/or mastication are excluded (21).

Food texture is defined as a group of physical properties that originate from the structure of the food, is sensed by touch in the mouth and with the hands, and is not related to taste and odor (22). Of the textural characteristics identified as most significant in dysphagia management by the U.S. National Dysphagic Task Force, pureed foods possess only viscosity, cohesiveness, adhesiveness, hardness and yield stress (21). Size of particulate matter has also been suggested as a textural characteristic that influences swallowing (23).

With normal swallowing, an individual is able to adjust to changes in viscosity, consistency, volume, mass and temperature of foods. Temperature, pH, volume offered, and size and shape of particulate matter, all affect the likelihood of a bolus passing safely through the swallowing process in dysphagic individuals (24). Strong flavors are recommended to stimulate swallowing and mastication, and bland foods are to be avoided (25). With most types of swallowing disorders, the textural characteristics of the food, including viscosity, consistency and homogeneity become critical to successful swallowing (2).

Although, dysphagia results from a plethora of problems in one or more phases of the swallow, food textures that are most often indicated for the management of dysphagia are described as moist, semisolid consistencies that form a cohesive bolus, with the avoidance of foods with more than one consistency (2). Pureed diets are recommended for individuals with oral motor deficits, pharyngeal weakness and/or poor airway protection (2).

A pureed diet is offered to 14-20% of LTC residents (3, 4) and although the diets required for dysphagic individuals should be highly individualized and altered with changes in a dysphagic individual's ability to swallow, this requires close monitoring with swallowing assessments which are time consuming, costly, and moderately invasive and, therefore, may not be done in an era of limited health care resources. Further, the suitability of typical pureed foods for dysphagic individuals has been questioned; LTC residents consuming traditional pureed foods had significantly more aspiration pneumonia than those residents consuming soft mechanical textures (26).

Viscosity is the mechanical characteristic that most influences the oral-pharyngeal transit time (2). It has been shown that oral transit time and oral-pharyngeal transit is

delayed with more viscous foods (27). Aspiration is significantly decreased when foods have slower oral-pharyngeal transit time as the person with dysphagia is better able to control mastication, transport and swallow (28). Increased viscosity of the bolus has been shown to prolong peristaltic contractive waves and the velocity of propagation of the bolus into the esophagus (29, 30). Other researchers have not confirmed this finding (31, 32).

Viscosity is also related to the tongue force required during the swallow and increases in viscosity require increased force (33). Pureed foods with high viscosities may become difficult to swallow due to the increased muscular effort required. "Medium-thick liquid boluses are the favored consistency, as they tend to alter the pharyngeal response to protect the larynx, a compromise between excessive viscosity and the tendency of thin liquids boluses to penetrate the larynx" (34).

Consistency is closely related to viscosity although other textural characteristics such as adhesiveness influence consistency determinations (35). The line spread test and Bostwick Consistometer have shown to be unsuitable tools, whereas the "spoonability" test is a suitable predictor of viscosity and may be an appropriate quality control indicator for pureed foods intended for dysphagic individuals (36).

Adhesiveness, which is the "work (force in grams) necessary to overcome the attractive forces between the surface of the food and the surface of other materials with which the food comes in contact such as tongue, teeth and palate (22) may influence the swallow and excessive adhesiveness may lead to delayed swallowing. Sticky foods such as white bread, mashed potatoes are contraindicated for oropharyngeal disorders as these foods require increased effort to move the food through the swallow (26). Martin (1991) comments that sticky foods, such as peanut butter or melted cheese, should be omitted from a pureed diet (37) as do current dysphagic diet standards (2).

Particle size may be critical in dysphagia management as larger particles may cause immediate choking (38). Food particles can be "pocketed" or "squirreled" in the cheek and/or under the tongue and may remain there until the end of the day (39). This may lead to later aspiration or choking. Size of particulate matter can be assessed with screens of varying mesh size with both wet and dry food products. Particle size of pureed foods should not exceed 1mm^2 (23).

Summary and Objectives

Pureed foods, intended for individuals with swallowing disorders, are recommended to be moist, semi-solid, cohesive and homogenous. The ideal consistency is "spoon- thick" or "pudding-like". As malnutrition is a risk for swallowing disordered individuals, pureed foods must be nutrient dense. However, pureed foods lack the adequate nutrient density to provide adequate nutrition to LTC residents consuming these foods. Pulses are appropriate constituents of nutrient-dense pureed-texture foods. This project was carried out with the intention of developing nutrient-dense, texturally appropriate and acceptable pulse-based pureed foods for swallowing disordered LTC residents.

The specific objectives of this study were:

1. To develop texturally-appropriate, pulse-based purees.
2. To evaluate the sensory characteristics and acceptability of folate-rich pulse-based pureed foods.
3. To determine baseline and treatment serum homocysteine in consenting LTC residents consuming pureed foods.
4. To recommend and implement menu revision with pulse-based and other higher folate pureed foods in a LTC facility.

Methods

Pureed Food Development

Prototype formulations of folate-rich pulse-based entrees of recommended textural quality were developed. Samples of the developed pureed foods were analyzed in duplicate for consistency, adhesiveness and hardness. Consistency (as an estimate of viscosity) was assessed by a spooned weight. Heaped institutional teaspoons of the developed pureed foods were weighed in triplicate. Pureed food was spooned using an institutional teaspoon and excess food adhering to the lower surface of the spoon was

removed by scraping the lower surface of the spoon three times on the edge of the beaker. A goal "spoonability" of 10-20 g/spoonful was targeted.

Adhesiveness and hardness was determined with the Texture Profile Analysis (TPA) method (Food Technology Corporation: Model TMS 2000). The 250-pound transducer was used during the analyses. The speed of the piston was set at 0.330 cm/s, the pressure at 1400 Kpa (200 pounds per square inch), the percentage of compression at 70%, and the height of the sample at 5 cm in the container. The pureed foods were tested at both room (21°C) and at serving temperatures (55°C). All assessments were completed in duplicate.

Sensory Evaluation of Folate-Rich Pureed Foods

Ethical approval was obtained from the Committee on Human Experimentation (Biomedical). A copy of the ethics submission is found in **Appendix A** and the consent form is found in **Appendix B**. A panel of cognitively functional, consenting, dysphagic LTC residents from Saskatoon LTC facilities, as well as family members and staff, were recruited through poster and newsletter advertising. Sensory volunteers completed descriptive sensory evaluation on the ten developed pureed food items.

Effectiveness Study

Ethical approval was obtained from the University of Saskatchewan, Committee on Human Experimentation (Biomedical). A copy of the ethics submission is found in **Appendix A**. Study volunteers were recruited by word of mouth from Parkridge Centre, Saskatoon, Saskatchewan. A copy of the consent form is found in **Appendix C**. Individuals determined to be palliative will be excluded from participation. Baseline serum homocysteine of 12 consenting LTC residents (age 18-60 years of age) consuming pureed foods was determined.

Pureed food menu revisions were carried out for eight weeks. A number of higher folate foods were prepared and used as substitutions for low folate menu items. In addition, the usual cream of wheat or oatmeal served at breakfast, pureed cold cereals (Corn Flakes®, Bran Flakes® and Cheerios®) were served on eleven days of the three-week cycle menu. Pulse-based puddings (chocolate, vanilla or pistachio) were included

eight times in the menu cycle. Other desserts served included banana bread puree (served twice in the menu cycle), pumpkin puree (served twice in the menu cycle), ginger snap puree (served twice in the menu cycle), and strawberry shortcake puree (served three times in the menu cycle). Chickpea salmon puree was also served as a substitution for pureed meat on two days of the menu cycle.

In addition, a sample of commercial pureed products were either added or used as a substitution to the pureed menu. An addition to breakfast was a scrambled eggs and toast puree, which was served on five days of the menu cycle. Other products, including tomato basil bread puree, savory bread puree, or garlic bread puree, were served every second day at either lunch or supper. Other commercial foods that were used as substitutions to the menu include pureed spinach (served four times in the menu cycle), pureed macaroni and cheese (served twice in the menu cycle), and pureed salmon sandwich (served once in the menu cycle). These substitutions were made because the commercial products contained more folate than the foods they replaced.

Food and beverage consumption was monitored by weighing portions before and after meals. The estimated nutrient content developed pureed food items and three-day dietary intakes of ten study subjects were determined using Food Processor® (). Folate supplement use was determined. Pre and post serum homocysteine was carried out in weeks one and eight of the intervention.

Paired T-tests were used to compare the pre and post study nutrient intakes and serum homocysteine values.

Results

Thirty-seven pulse-based pureed foods were developed, as well as with a sample of ten evaluated for sensory acceptability. Mean acceptability of the purees was 4.0 ± 1.0 (1 = unacceptable; 5 = very acceptable). The mean "ease of swallow" of all the purees was 4.3 ± 0.9 (1 = difficult to swallow; 5 = easy to swallow), aroma was 3.0 ± 1.3 (1 = not detectable; 5 = clearly detectable), flavor intensity was 4.0 ± 1.0 (1 = no flavour; 5 = strong flavour), smoothness was ranked 2.4 ± 1.1 (1 = very smooth; 5 = grainy) and stickiness/adhesiveness was ranked 2.6 ± 1.1 (1 = not sticky 5 = very sticky).

Selective nutrient content of the developed purees can be found in **Table 1**. The mean estimated energy content of the pulse-based purees was 120 kcal per serving. Most serving sizes were estimated to be 90 g. Developed purees contained 4.4 ± 1.9 g of protein, 1.8 ± 0.9 g of dietary fibre and 46 ± 22 μ g of folate per serving. Energy averaged 120 ± 52 kcal per serving. **Table 2** gives the nutrient content of an additional seven higher folate containing formulations not containing pulses.

The textural characteristics of a sample of the pureed foods are given in **Table 3**. The mean hardness and adhesiveness of the developed pureed foods was 7.9 ± 3.8 N and 5.2 ± 3.5 N·cm, respectively. Mean spooned weight of the pulse-based pureed foods was 16.1 ± 3.4 g per spoonful and mean line spread was 2.4 ± 1.2 cm.

The mean nutrient intakes of the study subjects are given in **Table 4**. The pre-intervention and post-intervention serum homocysteine values are given in **Table 5**. One third of the subjects evaluated had elevated serum homocysteine levels.

Table 1. Nutrient Content of Pulse-based Pureed Foods.

Pureed Food	Serving Size (g)	Energy (Kcal)	Protein (g)	Fibre (g)	Folate (µg)
Beans & Sprouts	90	112	3.9	3.1	63
Beany Lasagne	90	87	5.3	1.8	20
Thickened Caesar	98	47	1.6	0.9	34
Broccoli with Orange	78	26	2.1	1.7	37
Chickpea Celery	88	152	4.7	2.5	89
Chickpea Pink Salmon	94	152	8.8	1.5	57
Creamed Peas with Mushrooms	96	86	3.7	2.1	29
Ginger Snap Cookie Puree	45	184	2.9	0.5	34
Lentil Pistachio Pudding	92	126	3.9	1.1	48
Lentil Pumpkin Dessert	90	92	3.8	1.9	47
Lentil Spinach Soup	90	83	4.1	1.8	84
Lentil Vanilla Pudding	90	91	4.2	1.1	49
Lentil Chicken Noodle Soup	90	52	3.4	0.6	29
Meat Free Chili	90	77	4.0	3.1	40
Chickpea Couscous	90	73	2.6	1.5	33
Pulse Spaghetti and Tomato Sauce	90	67	3.0	2.4	32
South of the Border Salad	92	151	5.7	2.0	62
Chickpea Perogies	90	161	8.4	1.8	38
Strawberry Shortcake Pulse Puree	68	67	1.8	0.8	19
Mousaka Puree	72	145	3.2	2.4	39
Beans, Salsa & Bulgur	91	96	3.8	2.6	41
Lentil Chocolate Pudding	90	119	4.3	1.4	48
Chickpea Medley	93	148	5.9	2.9	105
Lentil Pina Colada	135	274	4.1	1.4	50
Chickpea Cottage Cheese	90	113	9.7	1.7	68
Strawberry Banana Shake	135	119	3.5	1.1	16
Raspberry Blast Yoghurt	150	155	4.8	2.1	23
Texas BBQ Beans	90	86	4.8	5.0	14
Oatmeal Cookie Puree	90	202	4.8	1.1	23
Bacon Creamed Spinach	90	199	9.5	1.6	83
Cilantro Surprise	90	75	4.1	3.1	62
Saucy Lentils	90	139	4.0	2.0	69
Banana Coconut Cream	90	108	3.8	1.4	47
Banana Bread Puree	58	92	2.6	0.6	15
Classic Cherry Cheese Cake	90	185	4.2	1.0	42
Strawberry Ginger Cheesecake	90	163	4.4	1.0	49
Mean ± SD		120 ± 52	4.4 ± 1.9	1.8 ± 0.9	45.5 ± 22.0

Table 2: Nutrient content of higher-folate containing formulations.

Pureed Food	Serving Size (g)	Energy (Kcal)	Protein (g)	Fibre (g)	Folate (μ g)
Avocado Pear Mouse	95	123	1.5	3.6	36
Baby Beets with Caraway	86	49	2.6	1.0	44
Honey Nut Cheerios® Puree	150	200	7.5	2.9	24
Raisin Bran® Puree	150	177	6.6	3.9	26
Cornflakes® Puree	150	208	5.9	0.8	25
Creamed Brussel Sprouts	78	80	1.9	1.6	28
Raspberry Delight	90	138	1.8	1.7	12
Mean $\pm$ SD		139 $\pm$ 60	4.0 $\pm$ 2.6	2.2 $\pm$ 1.2	28 $\pm$ 10

Table 3: Textural analysis of developed pureed foods.

Pureed Food	Hardness (N)	Adhesiveness (N.cm)	Spooned Weight (g)	Line spread (cm)
Vanilla Pudding ¹	10.5	5.7	ND	ND
Peanut butter ²	47.0	18.9	ND	ND
Tomato Sauce ³	3.4	0.0	ND	ND
Bran Flakes	31.3	14.9	22.8	1.0
Corn Flakes	21.1	10.1	ND	1.4
Bologna	17.0	12.3	ND	1.0
Chickpea Pink Salmon	12.6	8.2	18.1	1.0
Chickpea Perogies	9.5	2.0	17.4	2.6
Lentil Chocolate Pudding	9.2	3.5	20.3	1.9
Pumpkin Pudding	8.3	4.6	20.9	1.9
Honey Nut Cheerios	7.1	4.5	16.2	3.0
Brussel Sprouts	6.5	7.9	16.0	1.7
Cauliflower	5.6	7.9	17.9	1.7
Broccoli	5.2	6.6	16.3	1.9
Pistachio Pudding	5.2	1.8	12.0	4.1
Bacon Creamed Spinach	4.9	1.9	12.4	2.9
Cheesecake Puree	3.7	0.7	10.0	4.8
Mean $\pm$ SD	7.9 $\pm$ 3.8	5.2 $\pm$ 3.5	16.1 $\pm$ 3.4	2.4 $\pm$ 1.2

Table 4: Pre and post intervention nutrient intakes of study subjects.

Nutrient	Pre-intervention	Post-intervention
Calories	1341 ± 402	1243 ± 443
Protein (g)	49 ± 21	43 ± 15
Carbohydrates (g)	213 ± 73	182 ± 67
Dietary fiber (g)	11.3 ± 4.3	9.9 ± 3.7
Fat - total (g)	37 ± 13	42 ± 23
Vitamin A (IU)	13309 ± 24504	3418 ± 2013
Thiamin (mg)	0.7 ± 0.3	0.9 ± 0.4
Riboflavin (mg)	1.3 ± 0.5	1.3 ± 0.6
Niacin (mg)	13 ± 4.6	12 ± 4.0
Vitamin B6 (mg)	1.2 ± 0.7	1.0 ± 0.5
Vitamin B12 (mcg)	2.0 ± 1.1	1.8 ± 0.9
Biotin (mcg)	25 ± 36	38 ± 37
Vitamin C (mg)	95 ± 60	89 ± 51
Vitamin D (IU)	105 ± 135	110 ± 79
Vitamin E (IU)	2.5 ± 3.7	4.8 ± 4.5
Folate (µg)	139 ± 71	149 ± 83
Pantothenic Acid (mg)	3.0 ± 1.5	3.0 ± 1.6
Calcium (mg)	719 ± 313	745 ± 288
Iron (mg)	8.1 ± 4.5	9.0 ± 3.8
Potassium (mg)	2108 ± 859	1711 ± 668
Sodium (mg)	2112 ± 1021	2195 ± 910
Zinc (mg)	4.7 ± 2.6	4.5 ± 2.0

Table 5: Baseline and post intervention serum homocysteine.

Baseline Homocysteine	Post Intervention
10.41	9.72
12.75	12.65
7.05	7.30
12.07	12.31
45.61	59.62
9.01	9.88
15.71	18.93
9.64	7.95
23.44	25.05
17.24	14.75
10.94	11.61
5.43	4.79
10.8 ± 3.1	14.7 ± 4.2 (NS)

* (Normal range: 3.00-15.00 µmol/L)

Discussion

The high acceptability of the developed pureed foods indicates that whole pulses may be ideally suited for ingredients of pureed foods. In addition, pulse-based pureed foods offer the appropriate texture for swallowing, with hardness and adhesiveness similar to the "pudding-like" target. This investigation determined that one third of the residents consuming the pureed diet have elevated serum homocysteine and, therefore, may have inadequate folate intakes. As pulses are very good sources of folate, incorporation of an adequate amount of pulse-based pureed foods into the pureed diet may function to increase folate intake and reduce serum homocysteine.

However, in this study, only a limited number of the pulse-based foods could be incorporated into the institutional pureed menu due to limitations in staff time and technical capabilities. The facility was able to incorporate pureed cold cereals into the menu, but this revision did not result in an increase in folate intake. As well, the facility was able to change the practice of thickening soups with commercial thickener to thickening the soups with finely ground cracker crumbs, which are fortified with folic acid and other nutrients. Commercial foods, pureed breads and vegetables, as sources of folate, were also used to enhance the folate content of the menu. However, the commercial pureed breads had relatively low levels of folate due to the amount of non-bread ingredients needed to achieve the appropriate puree texture. The bread products were intended to replace the mashed potatoes, however, the residents usually still received the potatoes in addition to the bread. As a result, folate intake did not increase significantly with the intervention.

Conclusions and Recommendations

Pulses are ideal constituents of pureed-texture foods. This project was carried out, with the intention of developing nutrient-dense, texturally appropriate and acceptable pulse-based pureed foods for swallowing disordered LTC residents. Thirty-seven pulse-based formulations were developed, and sensory evaluation of these foods by the target consumers indicated that the developed purees were highly acceptable. Pulse-based pureed foods possess the textural characteristics of smoothness and low adhesiveness recommended for swallowing. Although this initial study did not cause significant

increases in folate and other marginal nutrient intakes, incorporating pulse-based pureed foods into the daily diet of LTC residents may result in increased nutrient intake.

The preparation of pureed foods is technically challenging and time consuming for typical food service staff of long term care facilities. In addition, there is evidence accumulating that pureed food produced by typical institutional methods may put dysphagic residents at risk. Thus, time, training, improved production and quality control methods are required for appropriate pureed food production. There is evidence that the menu offered is not appropriate to achieve targets levels of nutrients and intakes of many nutrients are inadequate. To improve the quality of pureed food offered as well as offer a nutrient adequate diet, LTC facilities may need to incorporate commercially-produced products. Commercialization of pulse-based pureed foods may function to increase improve the nutrient density, variety and acceptability of the pureed diet.

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Presentations

An abstract of the research will be submitted to the Dietitians of Canada's Annual Conference, June 2006, Halifax, NS.

Personnel Involved

Gerald Henriksen, Product Development, College of Agriculture

Courtney Coburn, Dietetic Intern, Saskatoon Health Region

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Photos

N/A

Project Material Developed

The developed pulse-based pureed food formulations have been submitted to the University of Saskatchewan's Industry Liason Office as potential trade secrets. Funding has been received from the Saskatchewan Pulse Growers (August, 2005)

Expense Statement

To be forwarded from the University of Saskatchewan's Financial Services.

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Appendix A



Biomedical Research Ethics Board (Bio-REB)

RESEARCHER'S SUMMARY FORM

<http://www.usask.ca/research/ethical.shtml>

REB File Number: _____

PROJECT TITLE: The Effect of Menu Revision with Folate-Rich Foods on Serum Homocysteine of Long Term Care Residents Receiving Pureed Foods. (Revised July 2, 2004)

PRINCIPAL INVESTIGATOR: Wendy J. Dahl RD PhD Candidate, SHR and Clinical Assistant Professor, College of Pharmacy and Nutrition.

DEPARTMENT: Manager of Food and Nutrition Services, Parkridge Center, Saskatoon Health Region

SUB-INVESTIGATOR(S): Teresa Isaac RD; Susan J. Whiting PhD, College of Pharmacy and Nutrition, Nadine Zello RD, Clinical Dietitian, Parkridge Center, Bob Tyler PhD, Department of Applied Microbiology and Food Science, College of Agriculture.

DEPARTMENT: see above

RESEARCH WILL BE CONDUCTED AT: The Sensory Laboratory, Department of Applied Microbiology and Food Science, College of Agriculture and Parkridge Center, Saskatoon Health Region, Saskatoon, SK.

1. Hypothesis (State briefly the nature and purpose of the research proposal, and the proposition the research is seeking to uphold. What potentially useful knowledge or clarification about therapeutic options will be advanced to justify the participation of human subjects in this research project?)

Inadequate folate intake is a major contributor to elevated serum homocysteine, associated with an increased risk of cardiovascular disease and neurological dysfunction. Grain products provide an important source of folate, and although grain products such as slurried breads and pureed pastas are indicated for use in the institutional pureed diet, the preparation of these foods is challenging and, therefore, limited. Thus, institutionalized individuals receiving pureed diets are not receiving the full benefit of folate fortification and have folate intakes much less than recommendations. Many intervention studies using folic acid supplements have demonstrated reductions in homocysteine levels; our intention is to investigate whether changes in food alone are sufficient. We hypothesize that the daily dietary folate intake of dysphagic residents will be improved by substituting folate-rich foods for the folate-poor fruits, potatoes and other vegetables currently offered on the pureed menu, resulting in reductions in serum homocysteine. The objectives of this investigation are: to develop and test 25 standardized (50 serving) recipes of legume/cereal and other folate-rich pureed foods possessing the appropriate textural qualities; to

carry out sensory evaluation of the developed pureed foods by cognitively-functional, dysphagic long term care residents, to implement folate-rich menu revision for 8 weeks; to assess the acceptability of pureed foods with plate waste audits; and to estimate caloric and folate intakes of 20 long term care residents receiving pureed foods. Baseline and treatment (following the 8 week intervention) serum homocysteine of long term care residents consuming pureed foods will be carried out. The folate requirements of institutionalized individuals consuming pureed diets are currently not being met. The results of this investigation will function to remedy this situation through acceptable, texture-modified foods, which will supply folate and other marginal nutrients as well as adding variety to the pureed diet.

2. Academic Validity (Provide evidence that the scientific reasoning and design of the project are sufficiently sound to meet the objectives of this project. Provide your own comments and if possible those resulting from peer review. Indicate if any other committee or agency has assessed the project's scientific validity):

The proposed study has undergone external review and has been funded by the Canadian Foundation for Dietetic Research. See attached letter of acceptance and reviewers comments.

If applicable, please indicate whether TPD approval has been obtained:

Yes _____ No _____ Pending _____ N/A X

3. Funding (indicate the source of funds supporting the research. If externally funded, state whether the grant or contract is still in application, or has already been awarded):

The researchers have received \$15,000.00 from the Canadian Foundation for Dietetic Research to carry out this study.

4. Disclosure of Potential Conflicts of Interest (indicate any motivation or incentives for conducting this study that arise external to the objectives of the study, e.g., will the investigator or institution be paid to conduct this research project? Note: The consent form should also include an introductory disclosure of potential conflict of interest statement, where applicable, indicating that this is a medical research study for which the study doctor, the institution, or both are being paid):

The applicants declare no conflict of interest.

5. Subjects

- a) Target Population (e.g., age, gender, medical condition, target enrollment, significant inclusion/exclusion criteria):

The subjects will be consenting, long term care residents who usual consume pureed foods (male and female) over 18 years of age who currently reside at Parkridge Center. Individuals with a status of palliative will be excluded from participation.

- b) Proposed Strategies for Recruitment (e.g., use of advertisements, brochures, physician patient records):

The study coordinator will explain the study directly the potential volunteers and volunteers for the sensory study and/or the homocysteine/folate study will be recruited.

6. Procedures (clearly identify treatment allocation design, and describe the medical and other procedures to be followed in obtaining research data, including questionnaires):

Sensory Evaluation of Folate-Rich Pureed Foods

Sensory evaluation of pureed foods by cognitively functional dysphagic long term care residents will be carried out. A panel of 10 cognitively functional, consenting, dysphagic long term care residents from Parkridge Center will be recruited through direct communication with the study coordinator. Sensory volunteers will be trained in sensory evaluation and required to complete a descriptive sensory evaluation on the 25 developed pureed food items. A sensory questionnaire using a 5-point Likert scale will be completed by sensory volunteers. The attributes of such flavor, easy of swallowing and overall acceptability will be evaluated. An example of the descriptive sensory questionnaire is given in Appendix A.

Effectiveness Study

Study volunteers will be recruited by word of mouth from one fully functioning long term care facility. Baseline serum homocysteine of 20 consenting long term care residents (age 18-60 years of age) consuming pureed foods will be determined. Individuals determined to be palliative will be excluded from participation. Folate-rich menu revision will be carried out for 8 weeks. Acceptability of pureed foods will be assessed with plate waste audits and caloric and folate intakes will be estimated. Food and beverage consumption will be monitored by weighing portions before and after meals. Complete nutritional analysis (particularly folate, B12, protein and calories) the original pureed menu, the developed pureed menu (with the newly developed pureed food items) and consumed pureed foods (5 day dietary intake of the 20 study subjects) will be determined using Computrition®. Folate supplement use will also be determined. Treatment serum homocysteine will be carried out following 8 weeks of intervention.

7. Time Period (indicate the dates when the research project is expected to begin and to be completed. A final status report must be filed with the Office of Research Services once data collection from the last subject is complete. ORS should be notified once the study site is closed.):

Timeline: Folate-Rich Pureed Food Product Development, September, 2004 – December, 2004
Timeline for Part 2: Sensory Evaluation of Folate-Rich Pureed Foods, January-February, 2004
Timeline for Part 3: Effectiveness Study, March -May, 2005
Timeline for Part 4: June 1- August 31, 2005 Part 4: Data Analyses and Manuscript Preparation

8. Data Storage (In accordance with recommended guidelines provide a statement outlining the procedures you will use to store securely the research data. State how long and where the data will be stored and identify the person who will be assuming responsibility for data storage):

Study results will be stored in the office of Dr. Susan Whiting.

9. Consent Form (include a copy of the consent form and/or any study information that will be used. If not using a consent form give reasons why).

See attached consent forms.

9. Signatures

Principal Investigator

Phone

Fax

e-mail

Department Head, Dean, Director, or Administrative Head

10. Contact Person and Mailing Address for Correspondence:

Wendy J. Dahl
College of Pharmacy and Nutrition

Appendix B

Participant Information and Consent Form:

July 2, 2004

Title of study: The Effect of Menu Revision with Folate-Rich Foods on Serum Homocysteine of Long Term Care Residents Receiving Pureed Foods: **Sensory Evaluation**

You are invited to be a volunteer in this study because you are a resident of a special care home and usually consume a pureed diet.

This study is not part of your usual care or medical treatment. You do not have to take part in this study. If you decide to take part, you can quit at any time for any reason. Quitting the study will not result in any penalty or loss of health care services.

If you volunteer for this study,

- You will be asked to participate in one, 1 hour sensory training session prior to evaluation.
- You will be asked to participate in 5 sensory (taste-testing) sessions where you will sample a variety of pureed foods (vegetables, fruits, legumes and grains) and evaluate the sensory characteristics of aroma, flavor and texture of the pureed foods.

There is the potential of unforeseen risk with participation in this study. You should report any serious side effects to the principle investigator and/or seek treatment.

Sensory evaluation will be carried out at the Sensory Laboratory in the College of Agriculture, University of Saskatchewan. An honorarium of \$5.00 per sensory session will be provided. You will be provided with transportation to and from the sensory sessions. Being part of this study will be kept private. No one other than the research people will know that you are taking part in this study. The information we find out from this study will be used to write a paper for a medical or nutrition journal. No names of study participants will be used.

This study has been approved by the Biomedical Research Ethics Board (Bio-REB) of the University of Saskatchewan.

If you have any questions about this research project, please call:

Wendy Dahl: 306 655 1310 Teresa Isaac: 306 655 3884 Susan Whiting: 306 966 5837

If you have any questions about your rights as a research subject, you may contact the chair of the Biomedical Research Ethics Board, c/o the Office of Research Services, University of Saskatchewan at (306) 966 4053.

The contents of this consent form have been explained to me. I have been able to ask questions about the study and these questions have been answered to my satisfaction. I have received a copy of the consent form for my own records.

SIGNATURES

Study Volunteer: _____ Date: _____

Research Coordinator: _____ Date: _____

Witness: _____ Date: _____

Appendix C

Participant Information and Consent Form:

July 2, 2004

Title of study: The Effect of Menu Revision with Folate-Rich Foods on Serum Homocysteine of Long Term Care Residents Receiving Pureed Foods: **Clinical Trial**

You are invited to be a volunteer in this study because you are a resident of a special care home and usually consume a pureed diet.

This study is not part of your usual care or medical treatment. You do not have to take part in this study. If you decide to take part, you can quit at any time for any reason. Quitting the study will not result in any penalty or loss of health care services.

If you volunteer for this study,

- You will be asked to provide two, 4 ml venous blood samples (to determine a blood marker for deficiency of the vitamin folate).
- You will be offered a pureed diet that includes pureed foods high in the vitamin folate for 8 weeks, but will be free to consume or not consume any of the pureed foods offered.

Taking a blood sample is a minimal risk procedure. You may experience some discomfort or bruising. As with any clinical trial, there may be unforeseen risks. You should report any serious side effects to the principal investigator and/or seek treatment.

Being part of this study will be kept private. No one other than the research people will know that you are taking part in this study. You will be provided with an honorarium of \$20.00 for participation in this study.

The information we find out from this study will be used to write a paper for a medical or nutrition journal. No names of study participants will be used.

This study has been approved by the Biomedical Research Ethics Board (Bio-REB) of the University of Saskatchewan.

If you have any questions about this research project, please call:

Wendy Dahl 306 655 1310 Teresa Isaac 306 655 3884 Susan Whiting 306 966 5831

If you have any questions about your rights as a research subject, you may contact the chair of the Biomedical Research Ethics Board, c/o the Office of Research Services, University of Saskatchewan at (306) 966 4053.

The contents of this consent form have been explained to me. I have been able to ask questions about the study and these questions have been answered to my satisfaction. I have received a copy of the consent form for my own records.

SIGNATURES

Study Volunteer: _____

Date: _____

Research Coordinator: _____

Date: _____

Witness: _____

Date: _____

